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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/687,308	10/16/2003	James E. Millerd	6162.004	7889

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EXAMINER

DETSCHEL, MARISSA

ART UNIT PAPER NUMBER

2877

DATE MAILED: 09/01/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/687,308

Applicant(s)

MILLERD ET AL.

Examiner

Marissa J. Detschel

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on October 16, 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-24 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-4, 7-14, 17-22 and 24 is/are rejected.
- 7) ☒ Claim(s) 5, 6, 15, 16, and 23 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 10/16/03, 03/08/04.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Information Disclosure Statement

The information disclosure statement filed on March 8, 2004, fails to comply with 37 CFR 1.98(a)(2), which requires a legible copy of each cited foreign patent document; each non-patent literature publication or that portion which caused it to be listed; and all other information or that portion which caused it to be listed. Copies of non-patent literature documents R.C. Gonzalez et al., Digital Imaging Processing, Addison-Wesley, Reading, MA, 1987 and C. Koliopoulos et al., "Simultaneous phase shift interferometer," SPIE Vol. 1531, pp. 119-127, 1991 were not provided with the application. The information disclosure statement has been placed in the application file, but the information contained in the aforementioned two non-patent literature documents referred to therein has not been considered. All the U.S. patent documents disclosed by the applicant on the information disclosure statement filed October 16, 2003 have been fully considered by the examiner.

Specification

The disclosure is objected to because of the following informalities: The variable ϕ in equation (13) for $\varepsilon(\phi)$ on page 26, line 11 of the disclosure is improperly defined in reference to the use of $\varepsilon(\phi)$ equation (12). The variable ε is disclosed as being dependent on absolute phase, and thus was written as $\varepsilon(\phi_{\text{spatial}}(x,y) + \phi_{\text{off}})$ in the previous equation (12). This notation for ε should further be used in equation (13).

Appropriate correction is required.

Drawings

The drawings are objected to because of the layout and misspelling of the label for figure 8, box 600. The label should read "Store Intensity Coefficients & Bad Pixel Map" with the appropriate use of spacing a proper spelling of the word "coefficients." Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application.

Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

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A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-4, 7-14, 17-22, and 24 rejected under 35 U.S.C. 102(a) as being anticipated by Feinleib, et al. (USPN 4,399,356).

In regards to claims 1 and 12, Feinleib discloses a device shown in Figure 1 that uses a prism (10) to divide a light beam (7) into sub-images (identical combined beams (7a, 7b, 7c, and 7d)) that follow separate paths to detectors (4a, 4b, 4c, and 4d). A geometric distortion in the form of a tilt is found using the detectors to sense a variation of optical power in each of the beams (column 2, lines 30-32). A geometric correction matrix is found by processing outputs from each of the detectors through an application of weighting correlations listed in the table in column 11 into algorithms (column 11, lines 32-59). This is done in the programmable algorithmic processor (PAP) of the device (column 12, lines 3-7). The output signals of the PAP are sent to a correction system with a movable mirror that moves to correct for tip/tilt (column 12, line 57 to column 13, line 2).

In regards to claims 2 and 13, the detectors of Feinleib's device are disclosed as detector arrays with means for dividing each of the sub-images into sub-regions (subapertures) (column 4, lines 41-43). These sub-regions undergo the process of finding a geometric distortion and determining a correction factor as disclosed for the sub-images already stated above. A correction coefficient is found from processing the outputs of quadrants I-IV of the detector arrays, and, thus, for each pixel of a sub-region using the algorithms as set forth above. The use of the subscripts *I*, *II*, *III*, and *IV* in the weighting factors of the algorithms with

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cross-correlations used to find the correction factors in the table in column 11 disclose this separation of measurements (table in column 11 and column 11, lines 32-59).

Regarding claims 3 and 14, Feinleib discloses the use of nutation to measure an average spot position for each subaperture to track a particular feature (centroid or "hot spot") of the object being measured (column 3, lines 6-12). This particular feature, in the form of a centroid, is used to find the subaperture wavefront tilt (spatial displacement) in the x- and y-directions on one of the detectors (column 8, lines 66 to column 9, line 15). Furthermore, the algorithms used in determining the correction factors for spatial displacement are linear combinations of the 16 detected signals represented by the four sub-images going to the detectors, and the four sub-regions of each detector (column 11, lines 61-66). Therefore, the factors used to negate spatial displacement are calculated using each sub-region of each sub-image.

In regards to claim 4, Feinleib discloses applying algorithms with cross-correlations by sine and cosine functions to the separate signals from each of the detectors. The algorithms involve weighting factors for the subaperture wavefront tilt in the x- and y-directions given in the table in column 11 that are given with respect to the sub-regions *I*, *II*, *III*, and *IV* of the detectors, as indicated by the subscripts. (table in column 11 and column 11, lines 32-59)

In regards to claims 7 and 17, Feinleib uses a calibration test pattern in the form of object image (1200) is used on each detector (sub-image) to detect a

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function of the alignment displacement (spatial displacement) of the subaperture wavefront tilt (Figure 12 and column 8, line 61 to column 9, line 15).

Regarding claims 8 and 18, Feinleib detects a difference in intensity of the detectors proportional to the tilt of the wavefront by comparing the intensities of the subapertures of separate detectors (sub-images) with one another (column 5, lines 20-26).

Regarding claims 9 and 19, the displacements in subaperture wavefront tilts of Feinleib's device are modulated by the quadrature terms $\sin \theta$ and $\cos \theta$, where $\theta = \omega t$. The variable ω represents the nutation frequency for which the displacements are measured at. (column 10, lines 23-25) Since frequency is dependent on wavelength, this also represents a modulated wavelength used in determining the displacement in subaperture wavefront tilts. This nutation frequency is also found in the cross-correlated algorithms used to find the correction factors for geometric distortion in each sub-image (table in column 11 and column 11, lines 32-59).

In regards to claims 10, 11, 20, and 21 a dark signal for each photodiode in the detector arrays is taken and stored by the electronic data processor of Feinleib's device (column 12, lines 36-39). This dark signal represents a signal for intensity. Calibration constants are determined by using an internal reference LED to calculate this dark signal and monitor the response for each cell of the detector array. This response of the detectors results in calculating calibration constants to be sent to the front end processor (1310) of the device. (column 12, lines 35-40) In this processor, the calibration constants, representing a transfer-

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function correction matrix, are sent to the digitized data coming from the separate detector arrays for removal of intensity distortion. (column 11, lines 27-33) More specifically, for claim 11, since the signals coming off the detector arrays represent data from the arrays, and, thus, the sub-regions of the sub-images, the same method is used to remove intensity distortion from the sub-regions of the sub-images.

Claims 22 and 24 are rejected under 35 U.S.C. 102(a) as being anticipated by Millerd, et al. (USPN 6,304,330 B1).

In regards to claim 22, Millerd discloses the use of a diffractive optical element (80) to split a combined wavefront (66) into a set of sub-images (sub-wavefronts) (70a, 70b, 70c, and 70d) that follow a spatially discrete path (column 5, lines 63-67). The detector array of the device is positioned so as to receive a plurality of phase-shifted interferograms and to spatially resolve each of them to be measured instantaneously (i.e. create a phase map) (column 6, lines 36-43). Multiple wavefronts are measured at each of several wavelengths using Millerd's device (column 3, lines 41-44), and during each measurement, a phase offset is introduced into the sub-wavefronts (column 5, lines 18-24). This results in a plurality of additional phase maps for each wavefront measured at each wavelength. The wavefronts measured are in the form of two wavefronts – a reference wavefront and an object wavefront. A software application averages the phase maps by calculating wrapped phase maps for each of the reference and object interferograms of the reference and object wavefronts of each measurement and subtracting them from each other. The result is then

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unwrapped to produce a corrected phase map of the phase change between the two interferograms. (column 12, lines 53-65)

Regarding claim 24, a phase offset is introduced in the reference wavefront of the device of Millerd by shifting the phase between the reference and object wavefronts (column 5, lines 18-24).

Allowable Subject Matter

Claims 5, 6, 15, 16, and 23 are objected to as being dependent upon a rejected base claim, but would be allowable is rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for indication of allowable subject matter:

As to claims 5 and 15, the prior art of record, taken alone or in combination, fails to disclose or render obvious the use of a surface equation fit through correction factors to correct for a geometric distortion in a set of sub-regions of a set of sub-images and a method for obtaining a correction coefficient from the surface equation.

As to claims 6 and 16, the prior art of record, taken alone or in combination, fails to disclose or render obvious said surface equation of claims 5 and 15 as being a polynomial.

A regards to claim 23, the prior art of record, taken alone or in combination, fails to disclose or render obvious the use of a random offset in a method for correcting phase-distortion by calculating phase maps from a set of sub-images that have been phase offset.

Additional Prior Art

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The prior art made of record is Feinleib (USPN 4,141,652).

Feineib discloses a method and device for sensing wavefront spatial distortions in a set of sub-images of a return beam of light.

Conclusion

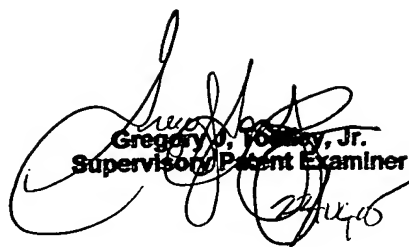
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Marissa J. Detschel whose telephone number is 571-272-2716. The examiner can normally be reached on M-F 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gregory J. Toatley, Jr. can be reached on 571-272-2059. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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MJD


Gregory D. Colby, Jr.
Supervisory Patent Examiner